

Challenges To Hatchery Program

- Limited water supplies
- Inability to isolate production
- Inability to exclude predators
- Crumbling raceways and pipelines
- Failure of \$2 million Treatment Sys.
 (Designed by Montgomery Watson)
- Loss of free heat to hatcheries beginning in 2003 (\$4,000,000 unrealized utility cost)
- Inability to produce catchable sized
 Trout, Chinook and Grayling
- 30% 50 % loss in productivity





Hatchery Sites



Immediate Response to Challenges

- Isolated Rearing Systems
- Redeveloped and Reclaimed Wells (2,000 - 3,000 gpm) a "Jack" thing
- Investigated Alternative Water Conservation Strategies
- Sent Staff to Recirculating Aquaculture Training Courses
- Constructed and Operated Pilot RAS for Evaluation
- Entire Facility running at 50% to 75% Reuse.





Why Consider RAS Facilities

- Freshwater Institute, Harry Westers and PR Aqua
- Toured Many, Many, Many, Hatcheries (Public and Private)
- Secure Environment for Staff and Fish
- Control Water Quality and Isolate Production
- Future Program Demands
- Lack of Alternatives
- Staff Commitment





Benefits

- •42 Isolated Systems
- •15 full RAS Systems
- Completely Enclosed
- •Up to 98% Recirculation
- Redundant Well Water Supply

•4 Automated Feeding Systems Cover all Feeding



Consistent Manpower Demand

Annual Production 143 mt

Micro Filtered Effluent

Public Access





Remaining Challenges

- Utility Costs
- Concentrated Waste
- Regulating Fish Growth
- •Stocking All These Fish!

RBSFH - Fairbanks

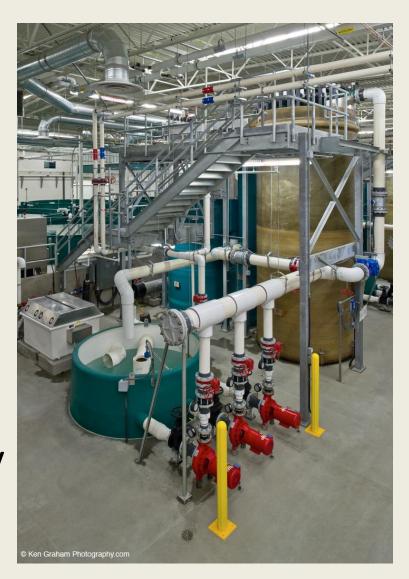
Benefits

- •18 Isolated Systems
- •5 RAS Systems
- Up to 98% Recirculation
- Automated Feeding System
- Completely Enclosed
- Micro Filtered Effluent to Sewer
- Visitor Area
- Annual Production 45 mt
 Remaining Challenges
- Utility Costs (\$0.23/KWH)
- •Maintaining Influent Treatment 0.9° C, Fe 7 mg/l, Mn 0.7 mg/l



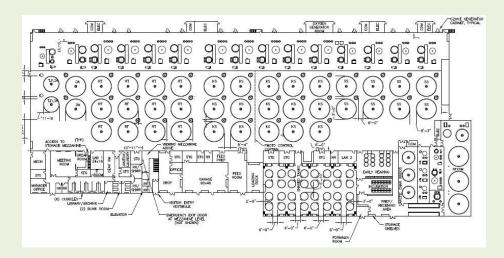
Project Obstacles (Large Projects)

- Politics
- Funding
- Bureaucracy
- Determining Need
- Large Consulting Firms
- Establishing Production Goals and Facility Scope
- Establishing Responsibility and Accountability



Design Management (Large Projects)

- Bureaucracy/Org.
- Establishing Process
- A & E Firms
- Communication
- Geography
- Staff Participation
- Decision Making
- Design Review
- Value Engineering



rity ID	Activity Name	Original	Start	Finish	Total S	Schedule %	Budgeted Total					2009				2010)
-,-		Durâtion			Float	Complete	Cost	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Fe
General Cond	litions	147	07-May-09	08-Feb-10	0	0%	\$124,847.00									-	_
Milestone		147	07-May-09	08-Feb-10	0	0%	\$0.00			+	-		-			$\dot{-}$	÷
GC001MSD07	Notice to Proceed	0	07-May-09*		0	0%	\$0.00	Notice to	Proceed								1
GC003MSKB0	Substaintial Completion * End of Contract Work	0		15-Jan-10	9	0%	\$0.00			1						◆ Subs	taintia
GC008MSKB0	Final Contract Completion	0		08-Feb-10	0	0%	\$0.00			1							
Job Wide - 0	General	147	07-May-09	09-Feb-10	0	0%	\$124,847.00		:							-	-
GC002JWKBG	Office Complex Set-up	10	07-May-09	21-May-09	164	0%	\$0.00	or or	toe Complex	Set-up							1
GC004JWKBG	Develop Punchlist	5	15-Jan-10	22-Jan-10	0	0%	\$0.00			1						- D	evelo
GC005JWKBG	Complete Punchlist Work	14	22-Jan-10	08-Feb-10	0	0%	\$0.00			1			1				;
	Office Complex De-Mobe		15-Jan-10	29-Jan-10	6	0%	\$0.00			1							Omo
GC007JWKBG	Project Closeout		15-Jan-10		6	0%	\$124,847.00										Proje
Select Demoi	lition	28	07-May-09	29-Jun-09	119	0%	\$24,750.00			29-Jun-09, S	blect Demolitic	an a					i
Civil North		24	14-May-09	29-Jun-09	0	0%	\$6,000.00	_	-	29-Jun-09, 0	Will North						1
DM001CNCEI	Demo North Berm Concrete Liner	4	23-Jun-09	29-Jun-09	0	0%	\$2,000.00			Demo North	Berm Concrete	Liner	İ	İ			ĺ
DM004CNCEI		3	14-May-09	19-May-09	- 11	0%	\$4,000.00	□ Der		Valve and Str.			1				1
Civil South		22	07-May-09	18-Jun-09	125	0%	\$7,750.00		V 18	Jun-09, CIVII S	outh	†	 				·
DM002CSCEL	Demo South Rem Concrete Liner	5	07-May-09	14-May-09	- 11	096	\$4,000.00	Demo	South Berm	Concrete Liner							1
DM005CSCEI	Demo SW Pond Drain and Structure			22-May-09	- 11	0%	\$2,000.00			Drain and Str	ucture		1				1
DM006CSCEI	Demo Overflow Drain and Pipe Under South Berm	2	11-Jun-09	15-Jun-09	164	0%	\$1,000.00		□ Den	Overflow Dra	and Pipe Ur	nder South Be	m			1	1
DM009CSCEI	Demo Natural Gas Pipeline	5	11-Jun-09	18-Jun-09	111	0%	\$750.00		□ De	mo Natural Ga	s Pipeline	i	i	i		1	i
Civil East		8	22-May-09	08-Jun-09	116	0%	\$8,000.00	-	▼ 09-Jun-	09, CMI East		1	†			1	1
DM007CECEI	Demo Intake Valve Box and Hardware	5	22-May-09	01-Jun-09	148	0%	\$4,000.00		Demo Intal	ke Valve Box a	nd Hardware		i				i
DM008CECEI	Demo Sump Building	5	01-Jun-09	08-Jun-09	148	0%	\$4,000.00		Demo S	Samp Building							1
Civil West		2	14-May-09	19-May-09	108	0%	\$3,000.00	▼ 19 1	May-09, CMI	West							1
DM003CWCE	Demo West Berm Concrete Liner	3	14-May-09	19-May-09	139	0%	\$3,000.00	□ Der	to West Berr	Concrete Line							1
Civil Constru		136	07-May-09	15-Jan-10	- 11	0%	\$2,693,646.00				 					▼ 15-Ja	h-10,
	Approvals, Procurement	- 11	07-May-09	20.May.00	0	0%	\$1,139,013.00		20. May no	Submittals, App	music Dracure	mont					
					0	0%	\$10,000,00			1	1						1
	Submittal and Approval of Sheet Pile Sheet Pile Procurement		07-May-09 14-May-09		0	0%	\$10,000.00		Sheet Pile P	oval of Sheet F	*			ļ			1
			25-Aug-09		0	0%	\$17.350.00	_	SHEEL FIRE F	i de la constant	_	20.419.00	uliding Area A				1
Building Are									ļ			1	i				ļ
	Backfill to Top of Footing - Area A		25-Aug-09 03-Sep-09		0	0%	\$17,350.00 \$17,350.00			1			o of Footing - A 09, Building A				1
Building Are							•,			1				;		1	!
	Backfill to Top of Footing - Area B		03-Sep-09		4	0%	\$17,350.00						o Top of Foot				1
Building Are			15-Sep-09		5	0%	\$17,350.00		1	1	i .		Sep-09, Buildin			1	1
CC021ACKBG	Backfill to Top of Footing - Area C		15-Sep-09		8	0%	\$17,350.00		Ĺ	<u> </u>	Ĺ	□ Ba	ektill to Top of I	ooting - Area	<u> </u>	i	L
Building Are	a D	2	24-Sep-09	28-Sep-09	7	0%	\$17,350.00			1			28-Sep-09, B		:		1
CC022ADKBG	Backfill to Top of Footing - Area D		24-Sep-09		12	0%	\$17,350.00			1			Backfill to To	of Footing - A	rea D		1
Building Are	a E	2	11-Aug-09	14-Aug-09	9	0%	\$17,350.00			1	₩ 14-Au	09, Building	Area E				1
CC023AEKBG	Backfill to Top of Footing - Area E		11-Aug-09		13	0%	\$17,350.00			1			oting - Area E				1
Building Are	a F	2	20-Aug-09	24-Aug-09	12	0%	\$17,350.00			1		Aug-09, Bu					1
CC024AFKBG	Backfill to Top of Footing - Area F	3	20-Aug-09	24-Aug-09	17	0%	\$17,350.00		1	†	B 8	ackfill to Top	of Footing - Are	a F		1	Ì
Building Are	a G	2	29-Aug-09	02-Sep-09	14	0%	\$17,350.00		i	i		7 02-Sep-09	Building Area	G	i		i
CC025AGKBG	Backfill to Top of Footing - Area G	3	29-Aug-09	02-Sep-09	21	0%	\$17,350.00			1		Backfill to	op of Footing	Area G			1
Actual Work	Critical Remaining Work Summary					Page 1	of 7			TASK	filter: All Activiti	ins.					=

Construction (3 years)

- Project Management
 - A&E Firm
 - Contractor
 - Owner
- Contingency
- Problem Solving
- Cost Reductions
- Additive Alternates
- Cost Management



Startup and Operation

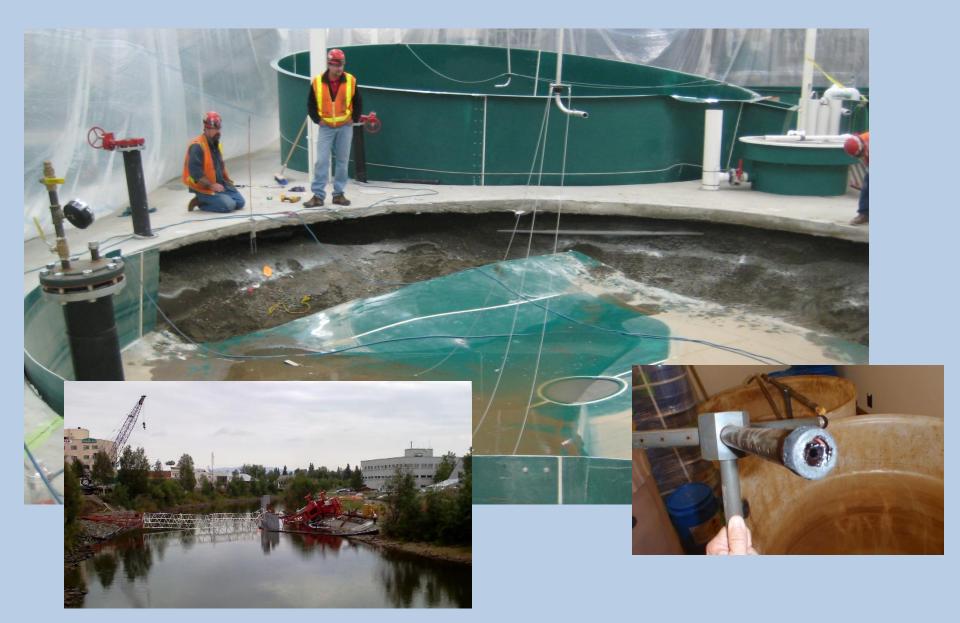
- Planning and Tracking
- Limited Loading
- Problem Solving



- Responsibility and Accountability
- Costs
- Staffing
- Training
- Stress

Label			L	T	RBT						RBTXXM		SS BL		SS JC		SS SC	
Life Stage			Subcatchable	Catchable	Fingerling	Subcatchable	Catchable	Brood 1.5-2	Brood 2-3	Fingerling	Catchable	Brood	Fingerling	Smolt	Fingerling	Smolt	Fingerling	Smolt
Date	start		7-Feb-09	10-Jul-09	25-Mar-08	1-Jul-08	29-Aug-08	15-May-09	30-Jan-10	25-Mar-08	20-Aug-08	30-Jan-09	1-Feb-08	1-Jul-08	1-Feb-08	1-Jul-08	1-Feb-08	1-Jul-08
	first release		10-Jul-09	15-May-10	15-Jun-08	29-Aug-08	15-May-09	30-Jan-10	30-Jan-11	20-Aug-08	30-Jan-09	30-Jan-10	15-May-08	15-May-09	15-May-08	15-May-09	15-May-08	15-May-09
	last release		10-Jul-09	15-Jun-10	1-Jul-08	29-Aug-08	15-Aug-09	30-Jan-10	30-Jan-11	20-Aug-08	30-Jan-09	30-Jan-10	1-Jul-08	1-Jul-09	1-Jul-08	1-Jul-09	1-Jul-08	1-Jul-09
Duration	min	days	153	309	82	59	259	260	366	148	163	365	104	318	104	318	104	318
	max	days	153	340	98	59	351	260	366	148	163	365	151	365	151	365	151	365
Unit weight	start	970	0.16	10.00	0.14	2.00	7.30	120.00	400.00	0.14	7.00	57.00	0.20	3.00	0.20	3.00	0.20	3.00
	end	g	10.00	160.00	2.00	7.30	120.00	400.00	1000.00	7.00	57.00	400.00	3.00	23.00	3.00	23.00	3.00	23.00
Weight increase		0.0	9.84	150.00	1.86	5.30	112.70	280.00	600.00	6.86	50.00	343.00	2.80	20.00	2.80	20.00	2.80	20.00
Condition factor (k) as W/L ³		g/cm3	0.0125	0.0125	0.0110	0.0120	0.0120	0.0120	0.0120	0.0110	0.0120	0.0120	0.0090	0.0110	0.0090	0.0110	0.0090	0.0110
Length	start	cm	2.3	9.3	2.3	5.5	8.5	21.5	32.2	2.3	8.4	16.8	2.8	6.5	2.8	6.5	2.8	6.5
	end	cm	9.3	23.4	5.7	8.5	21.5	32.2	43.7	8.6	16.8	32.2	6.9	12.8	6.9	12.8	6.9	12.8
Length increase		cm	7.0	14.1	3.3	3.0	13.1	10.6	11.5	6.3	8.5	15.4	4.1	6.3	4.1	6.3	4.1	6.3
		cm	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temperature unit growt	th rate (TUG)	cm/deg C	0.0055	0.0055	0.0037	0.0045	0.0045	0.0045	0.0045	0.0037	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045
Temperature		deg C	8.3	8.3	11.0	11.2	11.2	9.1	7.0	11.4	11.5	9.4	8.8	4.4	8.8	4.4	8.8	4.4
Survival assumption			98%	96%	66%	100%	96%	95%	95%	66%	96%	95%	99%	99%	95%	99%	99%	99%
Number of fish	start		44,882	43,984	1,739,067	338,284	338,284	4,853	4,367	4,491	2,964	2,696	671,564	484,848	127,592	121,212	939,979	787,879
	end		43,984	42,225	1,147,784	338,284	324,753	4,610	4,149	2,964	2,845	2,561	664,848	480,000	121,212	120,000	930,579	780,000
	released		0	42,225	809,500	0	319,900	243	4,149	0	150	2,561	180,000	480,000	0	120,000	142,700	780,000
	on-grow		43,984	0	338,284	338,284	4,853	4,367	0	2,964	2,696	0	484,848	0	121,212	0	787,879	0
Biomass	start	kg	7	440	243	677	2,469	582	1,747	1	21	154	134	1,455	26	364	188	2,364
	end	kg	440	6,756	2,296	2,469	38,970	1,844	4,149	21	162	1,024	1,995	11,040	364	2,760	2,792	17,940
	released	kg	0	6,756	1,619	0	38,388	97	4,149	0	9	1,024	540	11,040	0	2,760	428	17,940
Maximum allowable density		kg/m ³	80	80	35	35	35	30	30	45	45	45	46	60	46	60	46	60
Total volume of tanks required		m^3	5	84	66	71	1113	61	138	0	4	23	43	184	8	46	61	299
Volume per tank		m^3	1.4	40.1	8.2	8.2	91.7	91.7	91.7	0.16	8.2	25.6	8.2	91.7	8.2	91.7	8.2	91.7
# of tanks required		tanks	4	3	8	9	13	1	2	3	1	1	6	3	1	1	8	4
# of tanks used		tanks	4	2	1	.0	12	1	2	3	1	1	6	2	4	2	8	4
Actual tank volume		m ³	5.6	80.2	82	82	1100.4	91.7	183.4	0.48	8.2	25.6	49.2	183.4	32.8	183.4	65.6	366.8
Actual max density		kg/m³	78.5	84.2	28.0	30.1	35.4	20.1	22.6	43.2	19.8	40.0	40.5	60.2	11.1	15.0	42.6	48.9

Oooops!!!!

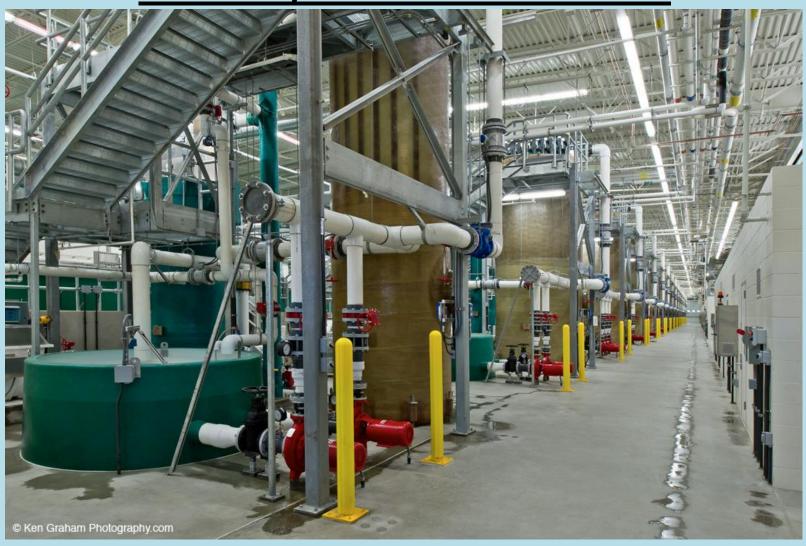


Recycle Systems

- -Radial Flow Settlers
- -Micro Screen Drum Filters
- -Pump Sump
- -Reuse Pumps
- -Fluidized Sand Bio-Filter
- -CO2 Stripper
- -O2 and O3 Injection
- -UV
- -Operating Temp 4 − 13° C



WJHSFH - 15 Recycle Systems in Primary Production Area





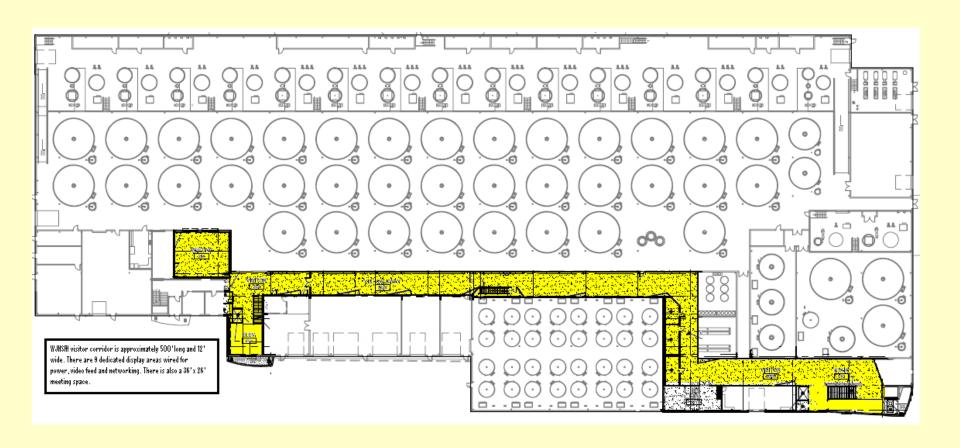
Feed Systems



Overhead Feed Delivery and Spreaders



Top View (Public Access Highlighted)



Visitor's Corridor



BY 2011 Rainbow Trout, Sept. 2011



BY 2011 March 2012



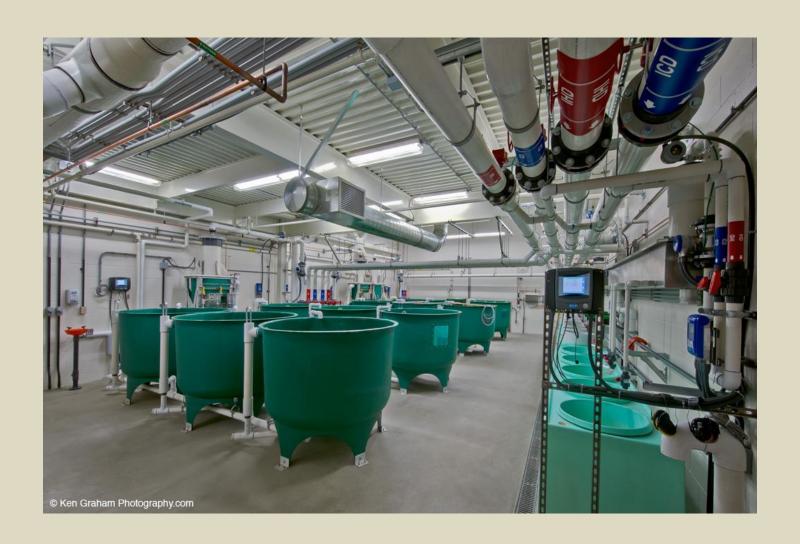
BY2011 Chinook, March 2012



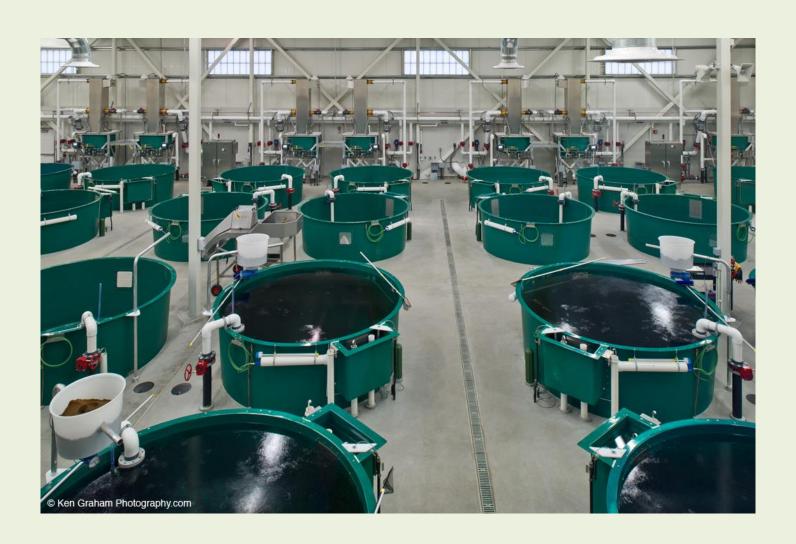
Incubation Room



Early Rearing for Broodstock and Grayling



Startup Rearing (Partial Reuse)



SCADA HMI Screen



Oxygen Sieve/Concentrators



Process Water and Building Heat Exchangers



Boilers



Backup Generators



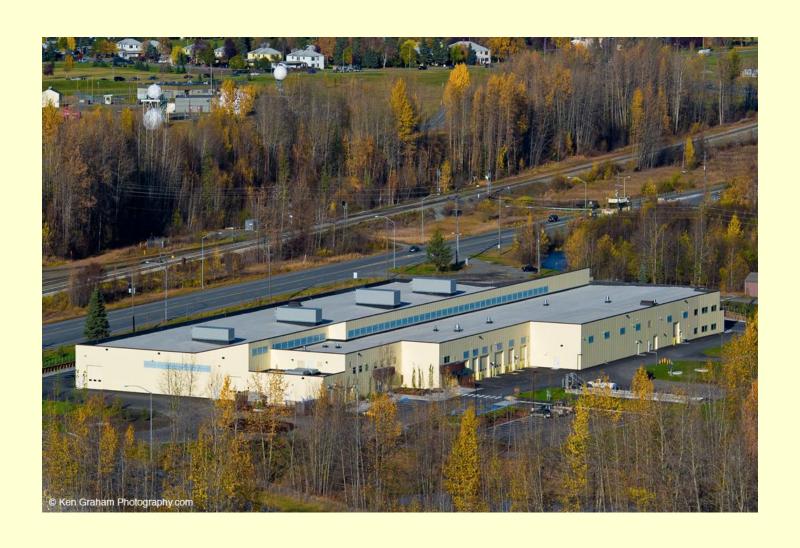
Main Entry Area



Hatchery Exterior



Over View of Facility (250'x600')

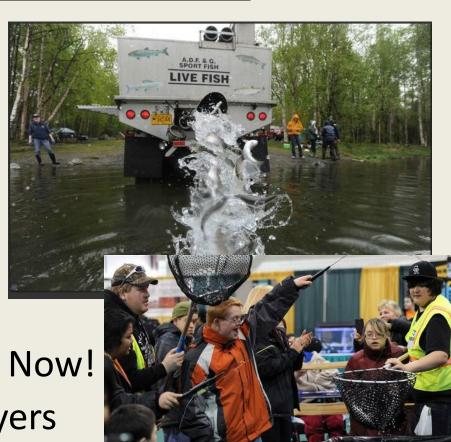


<u>Outcomes</u>

- RAS Work!
- Primary Goals Met
- Small Things Missed
- Steep Learning Curve for Staff
- Building Systems Management Critical
- Optimization Problematic
- Concentrated Effluent Disposal Still Challenging
- Some Staff Near Burnout (recovering quickly)

Recommendations

- Be Proactive
- Eliminate the word "NO"
- Always Include Staff
- Learn From Others
- Establish Clear Goals
- Establish Clear Process
- Start With a Pilot System Now!
- Minimize Third Party Players
- Focus on Solving Problems
 (Keep it from getting personal)
- Hold People Accountable (Design Build)



Was It Worth It? Heck Yes!!!!



Thank You

Harmannus "Harry" Westers

Beware of Dogmatic Statement such as, *Chinook cannot exceed a rearing density of 32 kg/m3*. Such declarations must be challenged....New ideas should constantly generate creative and innovative responses to operational and design practices (challenges)."

• Steve Summerfelt and Brian Vinci Freshwater Institute

Wayne Gorry and KC Hosler



ADF&G Hatchery Staff







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ADF&G Sport Fish Enhancement